the World Trade Organization (WTO) jurisprudence in the area and the improved accommodation between trade and environment over time. She further investigates the role of international trade law in linking indigenous culture and sustainable development, and emphasizes the relevance of the *EC–Seal Products* dispute[14] in determining that economic activities must be mindful of their implications for the culture of indigenous peoples and conservation of natural resources. However, she also notes the significant limitations of the WTO dispute settlement mechanism as a forum for adjudicating the infringement of indigenous people's cultural rights associated with nature.

For those toiling in the field of sustainable development with the aim of passing on to future generations a clean and wholesome environment, this book will provide compelling arguments over and insights into both progress and problems. The recent adoption of the Final Draft of the Outcome Document for the Post-2015 Development Agenda for adoption in late September 2015, *Transforming Our World: The 2030 Agenda for Sustainable Development*,[15] has revived our interest in the concept of sustainable development and its continuing evolution. It is fervently hoped that the goals announced in this document will be able to meet the strong preambular commitment of the world's political leaders: 'We are determined to protect the planet from degradation, including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change, so that it can support the needs of the present and future generations'.[16]

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Philosophy and the Precautionary Principle: Science, Evidence, and Environmental Policy, by Daniel Steel
Cambridge University Press, 2014, 266 pp, £60 hb, ISBN 9781107078161

Science and the Precautionary Principle in International Courts and Tribunals: Expert Evidence, Burden of Proof and Finality, by Caroline E. Foster
Cambridge University Press, 2011/13, £84.99 hb (2011), £25.99 pb (2013), ISBN 9780521513265 hb, 9781107669031 pb

The precautionary principle has taken hold in a variety of transnational environmental law contexts as a fundamental way to approach decision making in

14 Appellate Body Report, European Communities – Measures Prohibiting the Importation and Marketing of Seal Products, WT/DS400/AB/R, WT/DS401/AB/R, 22 May 2014, adopted 18 June 2014.

15 Available at: http://www.un.org/pga/wp-content/uploads/sites/3/2015/08/120815_outcome-document-of-Summit-for-adoption-of-the-post-2015-development-agenda.pdf.

16 Ibid., p. 1.

the face of scientific uncertainty. The scholarship that has grown up around the precautionary principle has had a theoretical side and a practical side. In particular, it has provoked theoretical debates about the nature of its underpinnings, as well as disputes about what precautionary measures are indicated (or not) in concrete cases. This review brings together two books that look at the precautionary principle from these two sides.

In *Philosophy and the Precautionary Principle: Science, Evidence, and Environmental Policy,* Daniel Steel offers an excellent theoretical study of the interface of science and environmental policy in general and the precautionary principle and its implications in particular. The book constitutes a timely addition to the literature on the definition and applicability of the precautionary principle. It offers insight into the philosophical and conceptual complexities of precaution in policy areas characterized by scientific uncertainty and environmental risks.

The book is divided into nine chapters. The first chapter focuses on the so-called precaution controversy and offers an excellent introduction to the debates surrounding the definition of the 'precautionary principle', by referring to the objections that have been expressed about its operational applicability in the field of environmental protection, its (lack of) distinctive character, and the contours of interaction with policy-relevant science.

From the outset, the author puts forward a new interpretation of the precautionary principle that attempts to bring together all its major conceptualizations as a procedural requirement, a decision rule, and an epistemic rule. The overarching theme of the interpretation advanced in this book is that the integration of the procedural, decisional, and epistemic aspects of the principle is also in accordance with the concept of consistency. Consistency plays an important role in safeguarding a more unified understanding of the precautionary principle across policy fields. In the second chapter, the author argues that the distinction between weak and strong interpretations of the precautionary principle is misleading and should be replaced with a more accurate contrast between the precautionary principle as a meta-rule and a decision rule that should not be susceptible to paralysis by scientific uncertainty.

The third chapter focuses on the lack of unity of the precautionary principle. It engages, in particular, with scholarly assertions that the principle is deprived of internal coherence and that no single perspective could capture the diverse range of conceptualizations of precaution. The fourth chapter, by contrast, brings forward an argument for a precautionary principle that rests on the history of environmental policy which has been characterized by belated responses to environmental hazards. The argument rests on the premise that rationality involves learning from mistakes and emphasizes the importance of taking action in the face of environmental hazards, despite uncertainties. Within this frame, a balanced illustration of both lengthy delays in response to emerging threats to human health and the environment and of costly and unnecessary environmental regulations is provided. Chapter 5 defines 'scientific uncertainty' as the absence of a model the predictive validity of which for the task in question has been well confirmed empirically. It aspires to improve the understanding of the interface between precautionary approaches and quantitative methods used to assess environmental policy decisions, particularly risk analysis and cost–benefit analysis.

The sixth chapter examines the relationship between the balance of interests of the present against those of the future and the precautionary principle, and develops a defence of intergenerational impartiality based upon the concept of a sequential plan. It argues that intergenerational impartiality, as an important component of the precautionary principle, should become an important element of sequential plans enacted in stages over an extended period of time. International agreements are examples of a sequential plan as they are directed at a particular environmental aim and must be implemented over a long time frame. Chapter 7 examines a rather controversial hypothesis that value judgments relating to human or environmental health can legitimately influence scientific assessments and defends the traditional distinction between epistemic and non-epistemic values. The author argues that this distinction is, in fact, useful for reconceiving the relationship between science and values after the demise of the value-free ideal. In Chapter 8, the author provides a concrete example of how the precautionary principle can function as an epistemic principle. He presents the values-in-science standard as a replacement for the value-free ideal as a normative guide for non-epistemic values that may legitimately influence the process by which scientists draw inferences from data. In the concluding chapter, the author recapitulates the central features of the interpretation of the precautionary principle and highlights specific aspects of his proposal for a values-in-science standard by using three case studies.

Understanding and explaining the plurality of conceptualizations and epistemic views of the precautionary principle is particularly important given the ongoing political and institutional developments in this field, and the respective legal, institutional, and political challenges that remain largely unsettled. The author takes up this challenge by setting out a readily understandable account of the major controversies surrounding the applicability and operational character of the precautionary principle and the challenges it poses for regulators and policy makers. Within this frame, the book is well timed and welcome, given its focus and critical perspective on some of the important long-standing theoretical questions surrounding the underlying assumptions and major components of a principle that has taken centre stage in a wide range of international discussions on the environment and human health.

To sum up, this is a well-written book, providing an example of academic scholarship at its best: thoughtful, revealing, provocative, and challenging. It is a useful addition to the literature on the complex understandings by which the precautionary principle is shaped, in order to accommodate a plurality of meta-rule, decision-rule, and epistemic aspects and aims. The book provides an overview of the most important strands of thought regarding precaution and arrives at interesting conclusions with regard to the implication of the precautionary principle for intergenerational equity, the role of the precautionary principle in distinguishing quantifiable from unquantifiable risks, and the management of unquantifiable risks. Ordinarily, the literature on the value and content of the precautionary principle is not examined in terms of the plurality of assumptions related to its connection with decisions, scientific procedures, and evidence. *Philosophy and the Precautionary Principle* is different in that it confronts the nature and contextual features of this

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controversial principle head on. It is poised to become a reference point for policy makers dealing with new and emerging technologies. Being meticulously researched and rigorously argued, it deserves, and will receive attention from a wide audience of scholars, especially in the fields of the philosophy of science and risk regulation.

Turning then to the practical side of the precautionary principle, the second book under review uses the international courtroom as the setting to examine how the principle has been interpreted and applied in litigation. In her book, *Science and the Precautionary Principle in International Courts and Tribunals: Expert Evidence, Burden of Proof and Finality*, Caroline Foster provides a highly informative account of the role of expert evidence in the peaceful settlement of international disputes where science is challenged, uncertain, or even contestable. The use and application of scientific knowledge by international courts and arbitrators is examined via careful analysis of a wide range of subjects, including fish stock conservation, radioactive pollution of water and air, global warming, coastal erosion, nuclear weapons, release of carcinogens in pulp and paper processing, white asbestos, use of growth hormones in beef production, and the safety of genetically modified organisms in the food chain and biosphere.

The examined cases arose before a range of different fora, including the International Court of Justice, the International Tribunal for the Law of the Sea, arbitral tribunals operating under the United Nations Convention on the Law of the Sea,[17] the World Trade Organization dispute settlement system, the Permanent Court of Arbitration and other arbitral tribunals, including tribunals operating under the World Bank's International Centre of Settlement of Investment Disputes.

Chapter 2 of the book addresses the technical and political cooperation of parties as a central element in the resolution of international scientific disputes, while Chapters 3 and 4 address the evolution of international adjudicatory procedure as well as the retention by international courts and tribunals of their legal decision-making authority. The fifth and six chapters examine the issue of the burden of proof in disputes involving scientific uncertainty as well as the potential for a reversal of the burden of proof under a precautionary approach. Finally, Chapters 7 and 8 analyze the implications of ongoing developments in scientific knowledge for the finality of adjudication and the evaluation of various procedural scenarios. The analysis is thorough and inspiring as it relies on a vast range of written and oral proceedings materials. By examining a large number of decisions by various international courts and tribunals, the book sheds light on the challenges raised by the increasing prominence of scientific expertise in determining scientific and policy-laden disputes. Foster takes the view that expert advice will have an important impact on judicial interpretation in scientific disputes, while international tribunals remain fully responsible for their decisions. The central question focuses on the role of the precautionary principle in allocating the burden of proof and accommodating expert claims and evidence in the frame of international adjudication of disputes that involve scientific uncertainty.

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[17] Montego Bay (Jamaica), 10 Dec. 1982, in force 16 Nov. 1994, available at: http://www.un.org/depts/los/convention_agreements/texts/unclos/closindx.htm.

Foster discusses in detail the difficulties with drawing a line between law and fact when experts are appointed by a court or tribunal to offer insights not only into exclusively scientific issues but also into the policy and/or legal aspects or dimensions of scientific input. She also analyzes how to deal with independent experts' beliefs about the appropriate degree of precaution and the extent to which expert testimony may be used to discharge the burden of proof that is usually shouldered by a litigant. Her analysis identifies an increasing coherence in the handling of procedural matters and growing interactions between the courts, which leads her to argue that a community of international courts is gradually taking shape.

Based on her analysis, Foster suggests a partial reversal of the burden of proof in international adjudication via the application of a precautionary *prima facie* approach, provided that scientific uncertainty and the risk of harm are above certain thresholds. She puts forward innovative recommendations on how to accommodate the precautionary principle within the international adjudicatory process.

The book does have a few shortcomings, namely, its narrow focus on the limitations of scientific expertise and the absence of any overarching conclusion with regard to the role of the precautionary principle. However, the focus on how exactly international courts and tribunals take into account expert evidence is a particularly interesting one. Echoing Steel's plea for coherence in *Philosophy and the Precautionary Principle,* Foster's examination provides valuable insights and suggestions regarding coherence in the handling of procedural matters that are associated with the control of scientific uncertainties. Her arguments that international courts and tribunals should modify their rules on the burden of proof in order to apply the precautionary principle in exceptional cases, and that their decisions should provide for the reassessment of cases when subsequent scientific developments may affect the basis of the decision, are worthy of serious consideration. The book is highly recommended as an important resource for judges, legal practitioners, academic scholars, and those engaged in dispute resolution processes and the provision of expert evidence in international adjudication.

The two books reviewed here make valuable contributions to our understanding of the precautionary principle from different directions. One text concentrates on theory, providing new ideas by which to understand the nature of the precautionary principle and its relationship with science, risk, law and policy. The other monograph focuses on the praxis of the courtroom, allowing us to see examples of the direct interpretation and application of the principle in the real world. Both approaches to the study of precaution are indispensable to each other because one without the other results in an impoverished understanding. This clearly ties these two books together, as does the intellectual rigour that both bring to their subject.

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